Ocean Restaurants

Paul DiGiacomo at the Jet Propulsion Laboratory in Pasadena.

My name is Paul DiGiacomo and I am a graduate student at the University of California, Los Angeles (UCLA) working toward a Ph.D. in Biology. I also work at the Jet Propulsion Laboratory (JPL) in Pasadena, California, where I interact with many physical, biological, and polar oceanographers. I am a biological oceanographer; this means I study the plants and animals living in the ocean, as well as how different ocean processes affect these organisms. I have always been fascinated by the ocean. As a kid, I remember looking at the ocean from shore, seeing its vast and unchanging surface. Then, I could not tell what was going on below that surface, but I knew something was going on out there. I later discovered that, when you know what to look for, there is much to see on the ocean's surface. And the things you see tell you a lot about what is happening at depth.

Figure 1. Slicks on the surface of the ocean, they appear as light-colored linear features. These are formed by Langmuir cell circulations set up by the wind. Each slick corresponds with a zone of convergence.

What I look for and study are naturally occurring sea-surface slicks which consist of plant and animal oil [Fig. 1]. Slicks are long (less than 1 kilometer to over 1000 kilometers), straight or curvy features, meters in width, and are glassy, oily, or scummy in appearance. If you have ever seen oil floating on water, that is what a slick looks like. Some slicks come and go fairly quickly, within minutes to hours, others stay around much longer, for days or weeks.

Slicks occur in convergence zones, areas where water comes together and sinks (also called downwelling). Organic material becomes concentrated in convergence zones; this calms and flattens the water, and develops a slick. Convergence zones are created by a variety of physical oceanographic processes, or motions in our oceans, such as internal waves [Fig. 2], eddies [Fig. 3], ocean fronts, and Langmuir circulations [Fig. 4]. Often associated with these features are divergence zones, places where water moves apart, and are filled by water rising, or upwells.

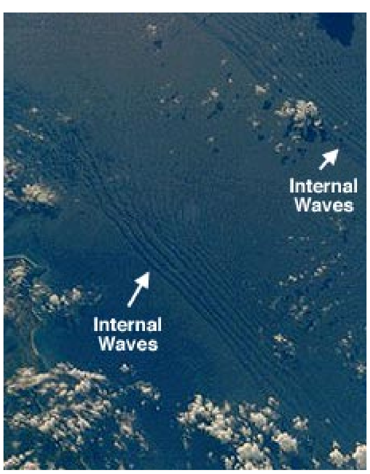

Figure 2. Shuttle photo of internal waves

So why do scientists study convergence zones and slicks? Slicks are important to biologists because *plankton* also get concentrated into these convergence zones and create hotspots for feeding, transport, and reproduction. In some ways slicks are like the restaurants of the ocean: they are good places for zooplankton [Fig. 5] and fish to find

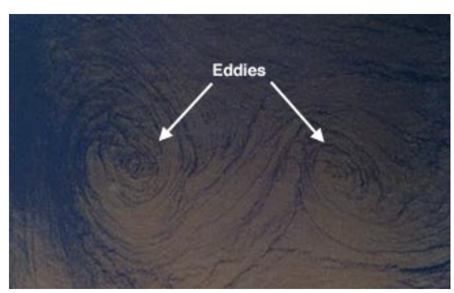

Figure 3. Space Shuttle photo of ocean eddies.

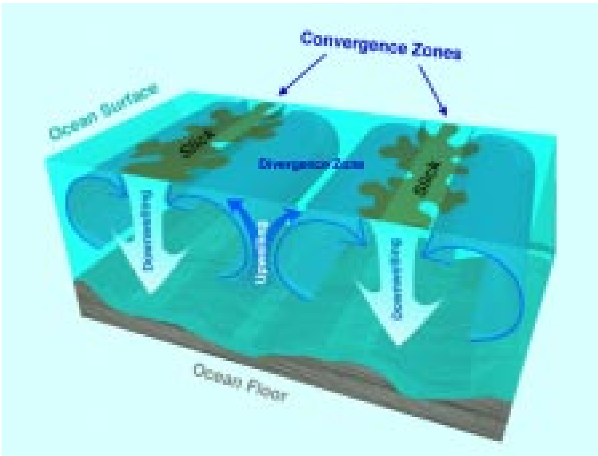

Figure 4. Wind-driven circulation cells which create convergence zones (sites of downwelling) and divergence zones (sites of upwelling) at the sea-surface, affecting the distribution of organisms. The convergence zones are often marked by slicks which are oriented roughly parallel to the direction of the wind, and are generally separated by a distance of meters to hundreds of meters. These features can come and go quickly, reflecting changes in wind direction and strength.

things to eat! However, slicks are not always beneficial for marine life — the same processes that cause good stuff to accumulate can also concentrate pollutants, leading to harmful conditions.

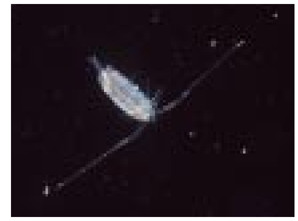

Figure 5. Copepod: This is a common type of zooplankton. They are about the size of a small ant and are a source of food for fish.

Although slicks are very important areas for biological activity, they are often small in size (compared to our oceans, that is) and short-lived. As a result they have been missed by large scale oceanography measurements where samples are taken many miles apart. We still haven't mapped all the places where convergence zones are likely to be found. This means there are probably many missing biological hotspots out there. However, it is getting easier to find these features because of satellite images, which I use in my research.

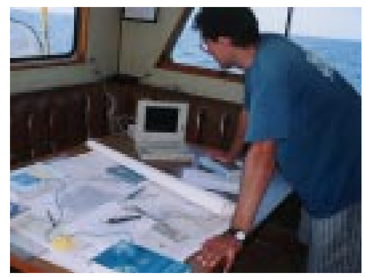

Figure 6. Paul DiGiacomo on the UCLA research vessel with charts and satellite images which he uses to locate sampling sites.

My major interest is in identifying when and where convergence zones / slicks occur off the coast of Southern California. I do this in many ways. First, I look at the big picture. I view digital satellite images to identify the physical processes that create convergence zones and slicks. Satellites can detect these in different ways: some satellites look at sea-surface temperature (from the Advanced Very High Resolution Radiometer, AVHRR), and others, like Synthetic Aperture Radar (SAR), look at the roughness of the sea surface. I also view photographs taken from Space Shuttle missions, as well as ones snapped from small planes that have flown off of Southern California's coast. I can even use my eyes, on land if I am high enough, or else on a boat!

Figure 7. Water sampling instrument known as a CTD because it measures the Conductivity (salinity), Temperature and Depth of water.

Once I know where the slicks are, I go out on UCLA's research vessel to examine the properties of slicks, then describe and measure the environment that created them [Fig. 6]. A water sampling instrument [Fig. 7] measures water temperature, salinity, and other physical characteristics. To determine the amount of *plankton* in the water, I use a tool called a fluorometer which measures the concentration of *phytoplankton*. I collect *zooplankton* with a net [Fig. 8]. If I want to discover the phytoplankton concentration over a much larger region, I can get ocean color data from a satellite instrument, SeaWiFS, which was launched in 1997. After I collect all of this data, I analyze it in the lab. I use microscopes to identify and count zooplankton from the net catch, computer programs to process and analyze the *CTD*, fluorometer and satellite data, and finally my own brain to put everything together. One of the most

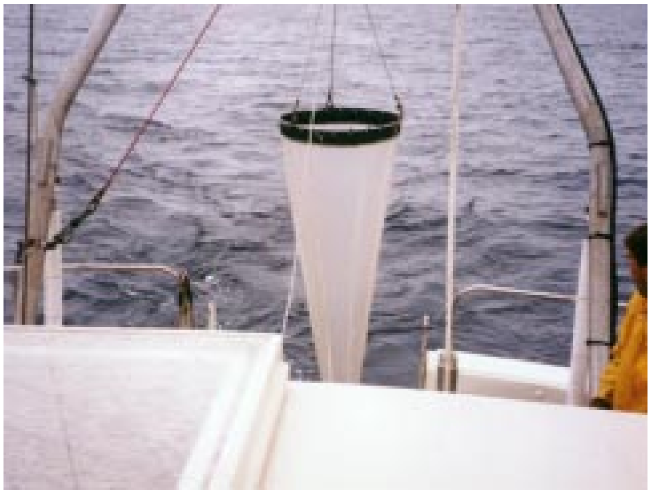

Figure 8. Plankton net which is made of very fine material. The plankton are funneled to the end as the net is pulled slowly through the water and then they are emptied into collecting bottles.

significant steps is documenting my findings so that they can be reviewed by other scientists. Then it is on to my next project — to investigate other questions and phenomena that I find interesting. I hope you see from this that not only is science interesting, it is also a lot of fun! Enjoy!